REMARKS

Claims 1-15 were pending in this case and all stand rejected. Reconsideration is requested. Claims 1, 3 and 4 stand rejected under §35 USC 102(b) as anticipated by Il'in. Further Claims 1-13 stand rejected under 35 USC § 103 as unpatentable over Hoyle.

Independent Claims 1 and 7 have been amended. It is respectfully submitted that the pending claims distinguish over the references.

In accordance with the invention, the single photon detector operates at temperatures below the critical temperature of the superconducting material. It has been found that the present detector operates better at lower temperatures; see specification at page 6, beginning at line 9 which states that the detector 12 is maintained at a temperature below 10 Kelvin (the approximate critical temperature of a thin NBN film) such as 4.2 Kelvin. Also, the current bias, instead of being a mechanism to translate the change of resistance into a voltage, is a critical adjustment and is set just about at the maximum current which the super conducting material can carry and remain superconductive. Thereby a single incoming photon causes a resistive hot spot in the superconducting material which the current must pass around, since that hot spot is not conductive. See Figs. 2A-2D. This results in the current in the remaining superconductive part of the strip causing a breakdown of superconductivity in this region 24 in Fig. 2D. Hence, a complete resistive break is formed across the width of the film as shown in Fig. 2D. The bias current flowing through this break causes a large voltage drop, on the order of millivolts, across the length of the detector strip.

The Il'in device in the reference is different in several significant respects. See Il'in page 3938, second column, second complete paragraph which begins "This letter presents the experimental responsivity and determines the ultimate quantum efficiency of the HEP based on a thin NBN film <u>in the resistive state</u>." (emphasis added.)

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Further, the Il'in detector does not operate at or below the critical temperature; see Il'in beginning of last paragraph on page 3939, first column, "Practically no photoresponse signal was observed at temperatures far above T_c, as well as below T = 10 K. We did not observe the signal at T < T_c..." (Emphasis added) Note that T_c is the highest temperature at which complete superconductivity, that is zero is resistance, occurs. Hence the Il'in detector operates nears its transition temperature where the detector is not quite superconductive but is resistive and preferably at the point where the rate of change of resistance against temperature is at a maximum, as stated in the same paragraph: "Thus, our study temperature range corresponded to the superconducting transition, i.e., near the maximum value of the dR/dT curve." Hence in the Il'in detector, an incoming photon causes a very small change in the resistance which can, in principal, be detected by applying a small current to the detector so that the resistance change is manifested by a voltage change across the detector. However, the voltage drop is very small. See Il'in Fig. 2 which shows (left hand axis) that the photoresponse signal is in the microvolt (MV) range, approximately 5-20 microvolts.

Hence it is clear that the Il'in detector operates differently from the inventive detector in terms of temperature, the nature and size of the resistive area caused by the incoming photon, and the resulting output signal. The nature of the resistive break in accordance with the present invention as shown in Fig. 2D and discussed above is such that the resistive break is across the entire width of the strip. This of course provides a relatively large voltage drop. However, no such wide resistive break is present in the Il'in detector.

This is emphasized by the fact that Il'in discloses that his detector strip has a "width W between 0.6 and 2 μm" at top of left hand column of page 3939. Hence, Il'in's is a relatively wide detector strip, since 0.6 to 2 μm equals 600 to 2,000 nm. In contrast, in accordance with the present invention, the strip in one embodiment is of width equal to or less than 200 nm; see for instance original Claims 6 and Claim 9. Hence, in accordance with the present

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invention, the narrower strip allows the complete resistive break of Fig. 2D. The wider strip of Il'in, combined with its different operating temperature and other different operating parameters, prohibit formation of such a complete resistive break and hence Il'in's is a much inferior detector for single photons.

Therefore, it is respectfully submitted that the claims distinguish over Il'in. Claim 1 as amended recites "providing a superconductor strip maintained at a temperature below its critical temperature;" clearly no such act is disclosed in Il'in. Instead, as discussed above, the Il'in detector operates at a temperature above the critical temperature. This is more than a variation in a parameter; it results in the difference between the resistive state of the Il'in detector and the superconducting state of the Claim 1 method. Hence clearly Claim 1 is not met by Il'in or obvious in light of Il'in and thereby distinguishes thereover as do dependent Claims 2-10 and new dependent Claims 16 and 17.

Additionally, Claim 6 distinguishes over Il'in because Claim 6 recites "said superconductor strip has a width equal to or less than about 200 nanometers" which clearly is not shown or suggested by Il'in.

New Claim 16 recites "said output pulse has a voltage greater than 1 mV." See specification page 16, lines 6-11 and Fig. 4C, horizontal axis showing the resulting output voltage signal. In contrast the Il'in output signal, as discussed above and shown in Il'in Fig. 2, is in the range of 5-20 microvolts. Clearly there is a significant advantage in having a much stronger output signal (by a factor of at least 50) in any type of detector.

Claim 17 is directed to the resistive break in the detector shown in Fig. 2D with the resistive break extending across the width of the detector strip. See also specification, page 7, lines 11-15 describing this phenomena. While this is not discussed per se, in Il'in it is clear from the above discussion that Il'in could not possibly provide a resistive break for a single photon across the width of the detector strip due to the wider detector width which he uses, in

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addition to the operating parameters in terms of biasing current and temperature. Hence Claim 17 distinguishes thereover by reciting "said single photon creates a resistive region extending across the width of said semiconductor strip."

Independent apparatus Claim 7 distinguishes over Il'in for reasons similar to those pertaining to Claim 1, because Claim 7 now recites "said superconducting film is maintained at a temperature below its critical temperature." As discussed above in conjunction with Claim 1, Il'in does not disclose or suggest this.

Claims 8-15 and new Claim 18 and 19 are dependent upon Claim 7 and are allowable for at least the same reason as is Claim 7. Additionally, Claim 9 recites limitations similar to those of Claim 6 and hence is additionally allowable.

New dependent Claim 18 recites limitations similar to those of Claim 16 relating to the output signal and similarly distinguishes over Il'in.

New dependent Claim 19 is directed to similar subject matter as Claim 17 with regard to the resistive region; hence, it is also additionally allowable over Il'in.

The second rejection, under §103 of Claims 1-13, cites Hoyle. This Hoyle rejection is traversed. The Examiner concedes in his rejection "Hoyle does not explicitly teach the use of this method for the detection of single photons. But one skilled in the art of light detectors would recognize the advantage of a detector with the sensitivity high enough to detect single photons." There is, as the Examiner admits, no mention in Hoyle of single photon detection. The Examiner attempts to counter this by stating "Hoyle does teach that strips with small widths are sensitive to lower energy impacts. (Col. 6, lines 19-37 and lines 42-46, and col. 9, lines 19-37 and lines 42-46, and col. 9, lines 12-34, Fig. 10.)"

However in these portions of Hoyle, there is again no discussion of single photon detection. There is no indication of what strip width would provide single photon detection or what level of current bias would provide same. Hoyle is clearly not enabling of single photon

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detection. The Examiner cites no motivation in the art or in the references for providing single photon detection in Hoyle. For instance, no combination of Il'in with Hoyle is relied upon by the Examiner.

It is well established that the motivation to modify a reference to meet the claim must be based on teachings in the art rather than general statements of intent. See *In re Lee* (United States Court of Appeals for the Federal Circuit) 277 F.3d 1330, 1338; 61 USPQ 2nd 1430, January 18, 2002. In re Lee the CAFC reversed a finding of obviousness by the Board of Patent Appeals and Interferences. The Court said "With respect to Lee's application, neither the examiner nor the Board adequately supported the selection and combination of the Northrup and Thunder Chopper references to render obvious that which Lee described. ... This factual question of motivation is material to patentability and could not be resolved on subjective belief and unknown authority. It is improper, in determining whether a person of ordinary skill would have been lead to this combination of references, simply to "use that which the inventor taught against its teacher."" The W.L. Gore case is cited in the case in support.

At most, the Hoyle rejection appears to be an "obvious to try" rejection based (using hindsight) on the invention rather than on the reference(s). Hence, the Hoyle rejection is believed to be unfounded and it is requested that it be withdrawn. These arguments pertain to the rejection of both independent Claims 1 and 7 citing Hoyle. Hence all the claims dependent upon each of base Claims 1 and 7 also distinguish over Hoyle.

Similar arguments as to Hoyle pertain to various of the dependent claims. For instance, the Examiner rejected Claim 6 which is directed to the width of the strip saying that "Hoyle teaches the advantage of using smaller widths with the advantage of the ability to detect smaller amounts of radiation... Therefore it would have been obvious to one of ordinary skill in the art to provide for a superconductor strip with a width equal to or less than

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about 200 nm in the modified method of Hoyle." Again, Hoyle does not teach any particular width meeting that recited in Claim 6; the Examiner merely conclusory states that any smaller width would be obvious, without providing any motivation to reach the particular width recited in Claim 6. Again, this is contrary to in re Lee. Hence Claim 6 distinguishes over Hoyle. Similar reasons pertain to Claim 9, dependent upon Claim 7, which thereby similarly distinguishes over Hoyle.

Therefore, it is requested that Examiner reconsider his rejections, withdraw same, and pass this case to issue with all of pending Claim 1-19 allowed. If the Examiner contemplates other action, please contact the undersigned at 408/453-9200.

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Version with markings to show changes made – APPENDIX A

1. (Amended) A method of detecting photons, comprising the acts of:

providing a superconductor strip <u>maintained at a temperature below its critical temperature</u>;

electrically biasing said superconductor strip; and

directing light onto said biased superconductor strip;

wherein said biasing is at a level near said superconductor strip's critical current thereby to detect a single photon incident on said superconductor strip.

7. (Amended) A photon detector comprising a superconducting film coupled to a bias source, wherein said superconducting film is <u>maintained at a temperature below its critical temperature and</u> biased near its critical current, and wherein said superconducting film has a dimension which allows detection of a single incident photon.

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